

EXHIBIT A



skin

A NATURAL HISTORY

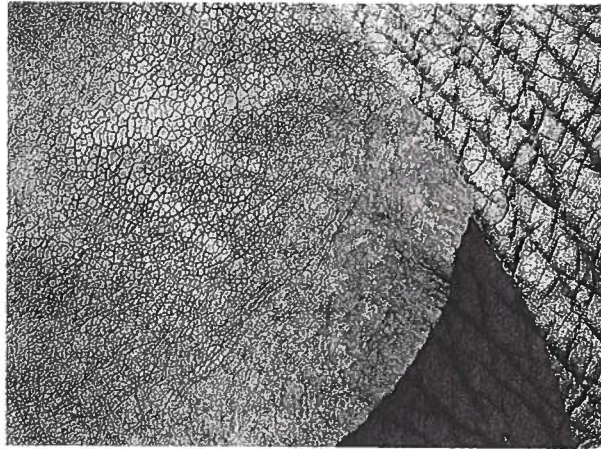
NINA G. JABLONSKI

"Nina Jablonski gives us the best account of everything you might want to know about the packaging of our anatomy." —JARED DIAMOND, author of *Collapse* and *Guns, Germs, and Steel*

skin

A NATURAL HISTORY

NINA G. JABLONSKI



UNIVERSITY OF CALIFORNIA PRESS *Berkeley Los Angeles London*

University of California Press, one of the most distinguished university presses in the United States, enriches lives around the world by advancing scholarship in the humanities, social sciences, and natural sciences. Its activities are supported by the UC Press Foundation and by philanthropic contributions from individuals and institutions. For more information, visit www.ucpress.edu.

University of California Press
Berkeley and Los Angeles, California

University of California Press, Ltd.
London, England

© 2006 by Nina G. Jablonski

Title page photograph © Heather Leah Kennedy

Library of Congress Cataloging-in-Publication Data

Jablonski, Nina G.

Skin : a natural history / Nina G. Jablonski.

p. cm.

Includes bibliographical references and index.

ISBN-13: 978-0-520-24281-4 (cloth : alk. paper),

ISBN-10: 0-520-24281-5 (cloth : alk. paper)

1. Skin. I. Title.

QP88.5.J33 2006

612.7'9—dc22

2006007731

Manufactured in Canada

15 14 13 12 11 10 09 08 07 06
10 9 8 7 6 5 4 3 2 1

This book is printed on New Leaf EcoBook 50, a 100% recycled fiber of which 50% is de-inked post-consumer waste, processed chlorine-free. EcoBook 50 is acid-free and meets the minimum requirements of ANSI/ASTM D5634-01 (*Permanence of Paper*).

- stratum granulosum, 13 *fig.*
 stratum spinosum, 13 *fig.*
 stress: "fight or flight" responses to, 51,
 112; skin's appearance and, 115, 116;
 touch and, 103, 104, 106, 107, 108, 111;
 virtual reality treatment for, 171. *See also*
 anxiety; depression
 stretch marks, 133
 structure, skin, 5, 6, 10. *See also* dermis;
 epidermis
 subcutaneous fat, human, 39–40
 suede, 183n8
 sunburn, 58; blood vessels in dermis and,
 17; hair protecting against, 19; skin
 phototypes and, 74; sweat gland
 condition and, 53. *See also* suntan;
 ultraviolet radiation (UVR)
 sun exposure, 56; freckles and, 83; head
 hair protection, 50; heat produced by,
 44; moles and, 123; skin color and, 37,
 37 *fig.*, 63 *fig.*, 69, 71–96, 159, *Plate 11*.
See also sunburn; sunscreens; suntan;
 ultraviolet radiation (UVR)
 sun protection factor (SPF), 83, 84
 sunscreens: freckles and, 83; future, 169;
 melanin as, 6, 14, 66, 71, 80–81, 83,
 84, 169; natural, 6, 10–11, 14, 34, 61,
 66, 71, 80–81, 83, 84; "red sweat" as,
 34, *Plate 5*
 suntan: artificial, 143, 160, 169; melanin
 and, 37, 37 *fig.*, 69, 71, 72–73, 77; popu-
 larity of, 159–60; skin cancer and, 73,
 137–38; skin pigmentation and, 74,
 82–85, *Plate 11*. *See also* sunburn
 superoxide anion, 72
 surgery, 21; laser, 152, 155, 213n20; plastic,
 143, 161, 163, 211n4; tattoo removal, 152,
 213n20
 suspensions, body piercings and, 154 *fig.*,
 155, 156 *fig.*, 213n23
 sweat glands, 46–51, 55, 113; apocrine, 46,
 49–51, 76, 189n15; dermis, 16, 17, 50;
 eccrine, 46–51, 76–78, 113, 189n15;
 fingerprints, 100 *fig.*, 101; keloids and,
 125; in primates, 51, 76–77, 113, 189n15;
 scars and, 125, 130; stratum corneum
 pores, 11–12. *See also* sweating
 sweating, 3, 6, 9, 39–55, 45 *fig.*, 56; cold, 7,
 113; emotional, 7, 51, 113–14, 115, 188n13;
 evolution of, 39, 43–51, 55, 113, 164,
 188n12; hairlessness and, 39, 43, 45–46,
 50; human, 38, 48, 49–50, 51; primate,
 37, 38, 51, 113, 189n15; rates of, 51–52;
 "reading" environment through, 113;
 thermal, 43–54, 47 *fig.*, 54 *fig.*, 78, 113,
 182n4, 188n13; transepidermal water
 loss vs., 34. *See also* sweat glands
 sympathetic nerves, 51, 112–13, 115, 116,
 207–8n8
 tactile sensitivity. *See* touch
 tails, monkey, 100 *fig.*, 101
 tanning: artificial, 143, 160, 169; leather,
 15, 183n8. *See also* suntan
 tapa (decorated barkcloth), 149, 149 *fig.*
 taste buds, external, 27
 tattoos, 8, 142–43, 148–53, 151 *fig.*,
 212–13n17; branding compared with,
 154, 155; future, 169–70; military,
 210n1; Myanmar facial, *Plate 13*; "Ötzi"
 (Neolithic-age "Iceman") and, 149,
 212n14, *Plate 2*; in Pacific Islands, 149,

tattoos (*continued*)

149 *fig.*; removal of, 152, 170, 213n20;
scarification instead of, 154; in Siberian
Russia, 149; temporary, 152

teens: pimples and acne, 131–32; puberty,
71, 207n1; youthful appearance desired
by, 160

teeth: evolution of, 117; grooming hair
with, 107

temperature: implanted sensors, 171;
receptor cells, 17; skin color and, 78;
touch sensing, 98. *See also* insulation;
thermoregulation

testosterone, 132

tetrapods, evolution of, 27–33, 62, 179

texture differentiation, touch and, 98

theatrical traditions, and facial makeup,
147, 147 *fig.*

thermoregulation, 9, 10, 17, 43–54, 179;
behavior for, 46; of brain, 16, 47 *fig.*,
48–49, 50, 188n14, 190n22; conduc-
tion, 44, 45 *fig.*, 188n14; convection, 44,
45 *fig.*, 55; evaporation, 44, 45–46, 45
fig., 47 *fig.*, 50, 54 *fig.*, 55; Fourier's Law
of Heat Flow, 190–91n30; fur and, 41,
43–44, 46; hairlessness and, 2–3, 33, 41,
43, 45–46, 77–78, 182n4, *Plates* 4, 7;
involuntary, 52; radiation, 44, 45 *fig.*,
50, 55–57, 57 *fig.*, 59, 78; sweating and,
43–54, 47 *fig.*, 54 *fig.*, 78, 113, 182n4,
188n13; voluntary, 52. *See also* insula-
tion; temperature

thickness: of dermis, 15; of epidermis,
182n2; of skin, 183n7; stratum corneum
thickening, 12–13, 183n4

ticks: bites of, 128; hairlessness and, 42

toads, skin of, 28

toes, primate, 98, 203n2. *See also* claws

toilet claw, 31, 32 *fig.*

Tollund Man, peat bog, *Plate* 3

touch, 10, 97–111, 202–6; autism and,
106–7, 205n20; during birth, 103–4,
204n11; communication through, 7,
8, 31, 102–3, 110, 142, 170; and elderly,
111, 206n33; evolution of, 97, 98, 103,
203–4n8; hands and, 19, 31, 32 *fig.*,
98–99, 99 *fig.*, 102, 203n4; haptic, 171,
177; healing, 111, 206n31; hooves and,
32; infants and, 103–8, 105 *fig.*, 109,
204–5nn11, 14, 16, 18, 205n19, 206n27;
Merkel cells and, 15, 19; nails and, 31;
primates and, 19, 31, 97–110, 170,
204nn14, 16; receptors, 98–100, 99 *fig.*,
104; remote, 8, 170, 171–72, 216n10;
robot, 166, 172–73, *Plate* 14; sexual, 103,
119–20; standards of permissible and
desirable, 109–10, 206n26; virtual
reality simulations, 171

toughness, skin, 9; dermis, 15; of elephants,
33; epidermis, 11, 14, 28, 30 *fig.*; keratin
and, 28, 30 *fig.*, 33; of rhinos, 33

transepidermal water loss, 34; in hippos,
34, *Plate* 5

treatment and healing, 166–68; of burns,
129, 130, 166–67, 215n1; gene therapy
and, 165, 168, 169; of psoriasis, 168;
of rosacea, 134; of scabs, 124; of scars,
125–26, 166, 168–69; touch used in,
111, 206n31; virtual reality treatment,
171; of war injuries, 143; of warts, 133;
of wounds, 168–69. *See also* diseases;
injuries

beings, do to our skin, a topic that has been the focus of many recent books.⁸ To appreciate the origins and great antiquity of skin decoration, we begin with a short history of the subject. As we survey various types of skin marking and trends in skin modification, you will discover that certain themes recur across cultures and through time. In particular, this chapter draws attention to how people have used cosmetics and paints to establish their identity and advertise their sexuality and explains how tattoos have served as ways of expressing either individuality or group affiliation in human societies.

The book's final chapter looks at future skin, from the prospects for custom-made artificial skin that can be used in clinical contexts to the expanding frontiers of communication and entertainment via remote touch. Skin and tactile communication have always been important to people, but they will soon become ever more so as we develop more sophisticated means for conveying and detecting remote touch. We are entering another brave new world in which skin will play new roles in interpersonal and broader social communication. For much of modern human history, skin has been a canvas for human creativity, setting us apart from our primate relatives with a mantle of uniqueness. So it is likely to remain.

appearance and intentions of other animals and our immediate environment is essential for survival.

In the course of our evolution, we have added substantially to this primate checklist. We also use our tactile and auditory senses as well as our highly evolved verbal communication skills to gather information about each other and our surroundings, though none of these have supplanted vision as the dominant mode of data collection. Today, humans are not just visually oriented; we are visually obsessed. In the modern realm, with the growth of digital communications media, where people increasingly learn about the world and each other through fast-paced imagery and auditory signals, appearance has come to assume an overwhelming primacy. The first impression that we read from a person's appearance—as conveyed primarily by skin (and its adornment), clothing, and jewelry—carries inordinate weight; it contextualizes and guides our subsequent interactions, often unconsciously.²

People use their skin as a canvas, to advertise their identity, their social status, and their social and sexual desirability. Humans have been deliberately altering the appearance of their skin for tens of thousands of years, possibly longer. Because skin is only rarely preserved in the fossil record, we can't precisely reconstruct the most ancient of these cultural practices. But the archaeological record does provide abundant evidence that humans were modifying their skin in various ways as far back as the later Paleolithic, and direct evidence from preserved and mummified skin attests to the pervasiveness of skin decoration since Neolithic times, from roughly ten thousand years ago to the present.

Body art, then, in its broadest sense has a long, complex, and interesting history. (I use the word "art" intentionally because the choices people make about decorating their skin are deliberate ones, based on a personal and cultural esthetic.) The first modifications were probably temporary markings placed on the surface of the skin, which constituted the earliest forms of painted body art and cosmetics. These were followed by more permanent modifications—tattoos, piercings, and scarification—as humans

developed the technical ability to deliberately and relatively safely breach the barrier of the skin.

Modern times have brought dramatic growth in what might be termed movements of corporeal and cutaneous self-expression—the art of our bodies and our skin. These pursuits reflect the contemporary preoccupation with “body work,” as people strive to transform and reconfigure their flesh through activities from dieting and bodybuilding to plastic surgery and gender reassignment, often involving sophisticated technologies or high levels of physical effort, will power, and pain.³ In particular, the past century has witnessed startling technological developments that allow us to make personal statements with our skin. Some of these, such as plastic and esthetic surgery, grew out of the pressing need to reconstruct the appearance of individuals who had suffered severe disfigurement during the horrors of two world wars.⁴ As in many other areas of medicine and technology, techniques developed to repair injuries or defects were quickly embraced for other purposes, to enhance appearance or function. In industrialized countries today, the means exist to change the basic canvas of the skin itself by adjusting its color and texture. Skin tanning and lightening, and a wide variety of methods for making the skin appear younger, are now available to those with sufficient time and money. As a result, humans of the twenty-first century can take advantage of a large and diverse assemblage of materials and techniques, accumulated over thousands of years, for expressing themselves through their skin.

Body Paint and Cosmetics

The earliest methods used to alter the skin's appearance involved the addition of color, using naturally occurring pigments. The discovery of paint pigments in archaeological contexts more than seventy-five thousand years old indicates that long before people covered their bodies with clothing, they adorned themselves with body paints.⁵ This is not surprising. Modern humans, after all, hail from equatorial climes where clothing is mostly superfluous. In addition, painting the body requires only pigment and imag-

ing parts of the body that are important in conveying emotional information and sexual attraction—the eyes, eyebrows, lips, and cheeks.

Products that emphasize the size and definition of the eyes and eyebrows, beginning with kohl in ancient Egypt and extending through all manner of mascaras, eyeliners, and eye shadows in more recent times, continue to be important to females. The appeal of these products is that they accentuate the size of the eye; the distance between the eye and the eyebrow; the upturning of the outer corners of the eyes, as in a true smile; and the conspicuousness of the “eyebrow flash,” the microexpression created by a brief raising of the eyebrows that signifies recognition and attention. The first two of these characteristics involve facial qualities that are used to distinguish female faces from male faces. Large eyes in adult human females are considered childlike, or neotenous, features. Children’s eyes seem relatively large because of the accelerated growth of the braincase and upper face during early childhood. Among females, growth of the lower part of the face during adolescence is generally less pronounced than it is for males, leaving women with faces that are more strongly dominated by their eyes.¹¹

No less valued have been products that emphasize the size and red color of the lips.¹² The lips are singularly important in verbal communication and kissing, which establish social bonds and physical intimacy with others. Cosmetics that heighten color in the cheeks are also extremely popular; radiant cheeks are associated with emotional and physical well-being, suggesting the rosininess of youth, the flush of sexual excitement, the rush of athletic exertion, or the bronzed visage of the relaxed vacationer. The earliest mass-produced rouges date from late eighteenth-century France, where they sold at an estimated rate of more than two million a year.¹³ With only minor interruptions since, cosmetics use and sales have climbed steadily.

Tattoos

Tattooing is another ancient form of body art and seems to have been a near-universal human practice. Dating back at least to Neolithic times, tattooing may represent the earliest form of irreversible body decoration. The



FIGURE 38. Complex patterns of geometric designs were used to decorate both household items and people of the ancient Lapita culture of the Pacific Islands. Similar motifs are found on ancient pottery, on modern tapa cloth (barkcloth), and in tattoos. The discovery of tattoo needles at many Lapita sites attests to the antiquity of the practice among the early peoples of the Pacific Islands. (Courtesy of Patrick V. Kirch.)

oldest known tattoos are those of Ötzi, the late Neolithic Iceman described in chapter 2, whose frozen body was found in an alpine glacier. His preserved skin, nearly 5,000 years old, bore fourteen sets of permanent marks believed to be tattoos—mostly short, parallel black lines found on his ankles and back, which seem to have been produced by rubbing soot onto the skin and then puncturing the skin and pushing the dark residue into the holes (refer back to color plate 2).¹⁴ Lavish tattoos featuring the figures of real and mythical animals decorate bodies nearly 4,500 years old that were recovered from the frozen tombs of the Pazyryk people of the Altai in Siberian Russia.¹⁵

The mummified bodies of high-ranking female Egyptians dating from the Middle Kingdom also bear tattoos, while a biblical injunction against tattooing dates to about this same time (Leviticus 19:28). Tattooing was widespread by three to four thousand years ago in Scandinavia, the circumpolar regions, the Americas, and Oceania; some of the most elaborate tattoos—those from Austronesia—also seem to have ancient origins. Archaeologists have recovered tattooing implements (needles and combs) from sites at the ancient Lapita cultural complex in the Pacific Islands, dating from 1200–1100 BCE, and considerable evidence from this location links the designs and motifs of tattoos with those used in the production of tapa (decorated barkcloth) and Lapita pottery (figure 38).¹⁶

Writings on the meanings of tattoos abound, but most authorities agree that the appeal of tattoos is that they represent a lasting inscription, conveying the importance of belonging, commemoration, and protection. Tattoos can declare a person's affiliation to a social unit. In some traditional Asian societies, for example, facial tattoos for women are considered beautiful within their own cultures but are reviled by outsiders; some groups use these facial markings as a way to bind women more closely to the group (see color plate 13). Tattoos substitute a decorated surface for the actual surface of the skin and, in doing so, transform the surface into an ambivalent statement of self-injury and self-defense. Because these decorations are usually permanent, tattooed skin can never regain the unmarked clarity of infancy.¹⁷

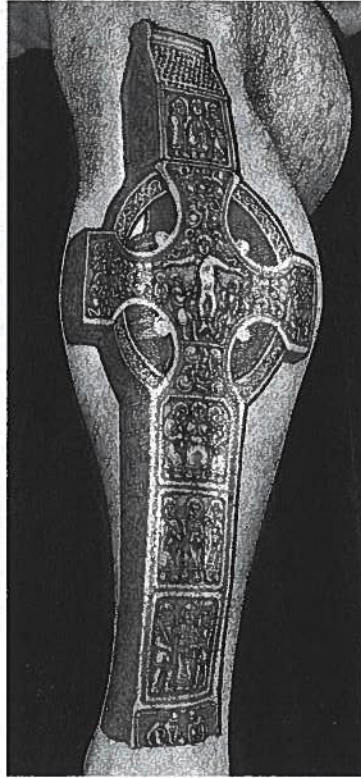
Tattooing was an integral part of most human cultures for thousands of years, but it clearly fell out of favor in most of Europe in the early Christian era, probably for reasons related to the biblical injunction against it. In subsequent centuries, the Western world came to associate tattooing either with the somewhat disreputable and marginal elements of society, such as prisoners and prostitutes, or with the primitive and the exotic, given the persistence of tattoos in other cultures around the world. Tattooing was, and in some circles still is, frowned upon in the Jewish tradition because it is considered an unholy practice.

Recent books on tattooing emphasize its ubiquity throughout history in an attempt to universalize and normalize it and render it once again attractive to modern, mainstream audiences.¹⁸ We know relatively little, however, about the history of methods and motifs of tattooing in the West because the subcultures and elements of society with which it was associated were not well documented until roughly the last century.

Today, tattoos are the most popular form of permanent skin art, with an estimated eighty million people in industrialized countries sporting some form of "ink." The appeal of tattooing is not only its permanence but also the richness of expression that the medium makes possible (figure 39). The large canvas of the skin permits images of widely varying sizes, colors, and complexity. To the surprise of the un-inked, people who choose to get tat-



FIGURE 39. Tattooing involves the injection of small amounts of permanent ink deep into the dermis, below the surface of the skin, using a sharp, hollow needle. On the left, artist Kira Od works on the details of a complex Celtic cross design on the front of Daniel McCune's lower leg. She works under sterile conditions in order to reduce the risk of infection. On the right, the finished tattoo of the Muiredach Cross provides a good example of modern ink—rich in detail, tailored to the body, and celebrating a life-changing event in a person's history. In this case, the cross recalls a memorable trip to Ireland Daniel took with his father. (Courtesy of Kira Od.)



toos generally do not regret their decision. Most tattoos are undertaken after much deliberation and forethought, and their permanence is their strong point. Tattoo designs—once imprinted on the skin—can be indelible reminders of a significant life event. They explicitly lack the transience of the souvenir t-shirt or a temporary hair color. In an increasingly globalized world of look-alike clothing, cosmetics, and hair styles, tattoos are permanent reflections of personality, carefully calculated representations of core beliefs and sentiments that can make a uniquely powerful statement of individuality.¹⁹

For many, tattoos signify a permanent and visible commitment to a group or class and thus serve as a badge of affiliation or disassociation. Although

they are usually acquired voluntarily, tattoos are sometimes inflicted involuntarily to mark an individual's membership in a particular group. Of all such markings, gang or prison tattoos make some of the most assertive statements of group membership. Tattoos are also often statements of romantic affiliation, incorporating a meaningful symbol or a lover's name. Individuals whose life circumstances change and who no longer wish to make such statements—they break with a gang, for example, or their romance ends—sometimes attempt to have their tattoos removed. Tattoo removal using various types of laser surgery is now possible, but the procedure is costly and lengthy.²⁰ When it was first introduced in the 1980s, laser removal of tattoos caused scarring in some people. New methods developed in the 1990s have eliminated this problem, but the procedure can still involve some transient loss of normal skin pigmentation in the treated area.

Modern tattoos are classified by style, with traditional, tribal, and gangster styles among the most popular. The increased appeal of tattoos since the 1980s in industrialized countries can be attributed in part to the rise of "celebrity tattoos." When cultural icons from the entertainment industry, such as Angelina Jolie and Brad Pitt, started showing off their tattoos at high-profile social events, it suddenly became acceptable, even desirable, to "have ink." As the practice of tattooing spread, a specialized vocabulary developed to describe individual designs and styles: now terms like "dark-side," "old school," "jailhouse," and "wild style" evoke specific styles of imagery. Many of the people who get tattoos in affluent countries today exercise great care in choosing the design and composition of their tattoo and the artist who will create it, sometimes going to great expense and traveling long distances to engage a famous tattoo artist in another city or to attend one of the many newly popular body art fairs.

The use of skin transfers ("temporary tattoos") or the painting of semi-permanent pigments on the skin can achieve esthetic effects similar to those of tattoos. The traditional art of henna skin painting, or *mehndi*, belongs to the latter category. Mehndi began as a traditional means of decorating a woman's hands and feet with complex designs painted with henna dye. The



FIGURE 40. Mehndi artist Ravie Kattaura paints the skin with henna, which imparts a semi-permanent design that usually lasts for seven to ten days and sometimes for as long as six weeks. In traditional contexts, the ceremony of applying the mehndi is as important as the effect of the finished design. (Photograph by Caroline Kopp, © 1992 California Academy of Sciences.)

tradition originated in North Africa and the countries of the Middle East and was brought to India in the twelfth century by the Moghuls. Originally reserved for brides-to-be, mehndi has become popular in recent decades as a mode of self-decoration among a wider spectrum of women in Asia and the West (figure 40). Mehndi typically lasts on the skin from seven to ten days and sometimes as long as six weeks, depending on how soon after application the skin was washed and how often it is washed in subsequent weeks. The application of a complex henna design, considered an important beautification ritual, can take up to six hours, especially for a bride.²¹

Piercing and Scarification

Piercing, scarification (cicatrization), and branding are widespread practices found in indigenous cultures on all continents, suggesting an ancient origin. Piercing likely provided a built-in means of affixing decorative and pre-

FIGURE 41. Traditional body piercings include extremes of self-mortification such as piercing the skin in the chest and back with multiple hooks, as Hindu fakirs sometimes did, and suspending the body weight by hooks forced into the chest wall, as in the famous suspension ritual, or *okipa* ceremony, of the Mandan people, captured here by artist George Catlin. This 1867 painting depicts a ceremony that took place around 1835.



cious objects to the body in early cultures where clothing was not widely used or needed. Whereas tattooing is more common among people with lightly to moderately pigmented skin, scarification and branding are seen more frequently among those with darkly pigmented skin. Highly melanized skin tends to form more prominent keloid scars, whose raised pattern is quite visible on the dark skin.

Like tattooing, piercing has become more popular in industrialized countries in the past twenty years. Long considered in the West to be the preserve of women who wanted a permanent method of affixing jewelry to their ears, piercing has become literally and figuratively more widespread, involving many parts of both the male and the female body. Piercings on parts of the face other than the ears are the most popular forms; they represent an extension of the trend toward multiple ear piercings that became popular in the 1980s. Facial piercings have become so fashionable and commonplace in the past decade that simple ones are performed in kiosks at shopping malls.

Piercing other parts of the body was first associated in the West with sado-masochistic relationships and the modern primitive movement of the 1970s, which sought to overcome the numbing effects of modern technology and industrialization on the senses by encouraging permanent body modifications as forms of spiritual exploration and personal expression. These practices derived their inspiration from Asian fakirs and Native American warriors who sought to express their spiritual power through feats of self-torture, such as piercing the flesh with weighted hooks or suspending the body from hooks (figure 41). Punk-rock performers of the 1970s and 1980s emulated more traditional feats of piercing. By making self-injury part of their acts, they sported extreme body modifications in order to make "anti-fashion" statements offstage.²² A different philosophy is embraced by the performance artist Stelarc, who has performed body suspensions as part of his continuing effort to escape the confines of the skin and eliminate the barrier between the public space and the inner space of the body (figure 42). To him, the suspension is "a manifestation of the gravitational pull, of overcoming it, or of at least resisting it. The stretched skin is a kind of gravitational landscape."²³

Like tattooing, body piercing has given rise to its own jargon to describe types, styles, and regions of piercing. Intimate body piercings involving the nipples and genitalia of both sexes are becoming more common as individuals seek alternative forms of sexual expression as well as the expressions of personal and group identity common to other forms of permanent body art.²⁴

Scarification is a decorative procedure based on the body's own penchant for building visible scars—especially the highly melanized keloid scars found among dark-skinned people—when the skin suffers a severe burn or a deep cut. Scarification can be created by branding or cicatrization. In branding, hot pieces of metal that have been fashioned into a desired shape are heated and applied to the skin in order to create a second- or third-degree burn. Because the scar resulting from the burn is typically much larger than the original lesion, allowing for less intricacy, the designs tend to be much simpler than those used in tattoos. Some body artists have recently introduced the use of surgical lasers to inscribe "brands."²⁵ Cicatrization is performed by

genes switched on by this cascade appear to be activated by mechanical stress on cells. Identifying the genes underlying the JNK cascade should help researchers discover new therapies for skin healing, which are desperately needed for chronic wound healing (treating leg ulcers in people with diabetes, for example) and burn treatment. Thus, we can look ahead to a time when, at least for some, scars will become a thing of the past.

Communication

Advances in treatments for damaged or diseased skin will be dramatic, but they will be overshadowed in the public arena by new ways of enhancing the skin's appearance and making it into an even more dynamic surface for the communication of experience and aspiration. Trends that emphasize the value of youthful skin, the use of cosmetics and cosmetic surgery, custom skin coloring, and various modes of skin decoration show no signs of abating, as chapter 10 points out.

It is easy to imagine, for instance, that gene therapy may someday be able to prevent or reverse aging processes in the skin. Less in the realm of fantasy are new injectables, especially for the face and neck, that are designed to stimulate epidermal regeneration, tighten up sagging folds, or plump up incipient creases. Cosmetics will undoubtedly become increasingly chemically sophisticated, with even greater emphasis on color enhancement delivered along with therapeutic agents ("cosmeceuticals") or with new compounds designed to change the mode of light reflectance from the surface of the skin.

Methods of changing skin color, whether permanently or semi-permanently, will become more varied and sophisticated. Ever more natural tans will be created by tanning and sunscreen products containing melanin or melaninlike pigments, as well as by activation of the body's own melanin production in the absence of sun. Or, in contrast, people will be able to bleach their skin by reversing the same process and deactivating melanin production at the cellular level.

Tattoos will become even more popular when less expensive and labo-

rious methods of tattoo removal become available. We can envision tattoo inks that can break down into harmless and invisible by-products after a defined period of time or after sustained exposure to a single wavelength of visible light, thus obviating the need for painstaking laser removal of embarrassing names or incriminating symbols.

Our consciousness of physical appearance and modern society's emphasis on our skin as a billboard for self-advertisement will only continue to grow. The billions of dollars currently spent each year on enhancing the appearance of skin may seem paltry in just another decade or so, as we strive to make ourselves appear more youthful, interesting, or singular by modifying our skin.

The coming years will also witness increased emphasis on enhancing and expanding the skin's communication functions by computerized information transfer using direct and remote touch. The deliciously acute sense of touch that we share with other primates will be rediscovered and stimulated in new and unforeseen ways. Already we can implant information-bearing microchips (radio frequency identification, or RFID, chips) in the skin, a technique that is being widely used to identify pets, livestock, and human medical patients.⁶ The idea of implanting microchips carrying personal information has been slower to catch on among the general populace for a variety of good reasons, mostly related to basic civil rights.⁷ But it is easy to imagine that people will soon be wearing a variety of such devices, some implanted voluntarily and temporarily, some not. It is already possible, for instance, to pay for an evening of partying at a nightclub in Spain by drawing against your prepaid account—an account whose details are held in a tiny microchip inserted under your skin at the beginning of the evening, so that you needn't carry a credit card or wallet.⁸ Many other types of personal information could be contained in embedded microchips, everything from your own DNA sequence to your entire medical or credit history or a record of criminal convictions.

Perhaps less worrisome would be devices able to transmit or receive information concerning conditions within your body or the environment. Im-

skin loses some of its effectiveness as a barrier, and many of its functions decline or become slower, including cell replacement, wound healing, sweat and sebum production, vitamin D production, and DNA repair, among others.

14. The literature on skin cancer is vast. For recent overviews of the causes and epidemiology of skin cancer, see Christenson et al. 2005; de Gruijl and van Kranen 2001; Sturm 2002; Garland, Garland, and Gorham 2003.
15. These estimates are based on figures provided by the American Cancer Society, whose useful Web site on nonmelanoma skin cancers is available at www.cancer.org/docroot/CRI/content/CRI_2_4_1X_What_is_skin_cancer_51.asp?sitearea=.
16. Erb et al. 2005; Cleaver and Crowley 2002.
17. Christenson et al. 2005.
18. Sturm et al. 2003; Newton Bishop and Bishop 2005.
19. Many factors determine the prognosis of melanoma. These include the thickness of the lesion, the degree of ulceration of the primary lesion on the skin, and the amount of lymph node involvement. Factors such as a person's age and the site of the lesion also make a difference in the likely clinical course. In malignant melanoma, the site of the metastases and their associated blood supplies strongly influence the outcome (Homsy et al. 2005).
20. For more information on preventing skin cancer, see the excellent online resources provided by the National Cancer Institute, available at www.cancer.gov/cancertopics/pdq/prevention/skin/Patient/page2.

Chapter 10. Statements

1. Throughout human history, tattoos have been important for identifying those who have died in battle. Even today, official applications for the military and various forms of formal identification include questions about any permanent marks or tattoos on the body that might be useful in establishing a person's identity after death.
2. Learning how to evaluate and properly act on the visual perceptions of a first impression is a skill. In his widely read book *Blink*, Malcolm Gladwell (2005) argues that first impressions are often correct and that the layers of cultural

pher Henshilwood and colleagues describe the discovery of the earliest documented use of red ochre in probable body decoration, in Blombos Cave in South Africa (Henshilwood et al. 2002). For good general discussions of the history of body painting, see Groning 1997; Walter et al. 1999.

7. Groning 1997.
8. Groning 1997; Walter et al. 1999.
9. Groning 1997.
10. White lead continued to be widely used in Europe through the 1820s, when it was replaced by zinc oxide. We will likely never know the extent of neurological morbidity or mortality that resulted from this source of lead poisoning.
11. The development of the face during childhood and its significance for relative eye size in adults is discussed in several studies; see Brown and Perrett 1993; Campbell et al. 1999; Schmidt and Cohn 2001.
12. Adding red coloring to the lips is a widespread practice of considerable antiquity, known to have occurred in Middle Kingdom Egypt and classical Greece. Reddened lips were popular in Europe from medieval times onward but were not always socially sanctioned. Meg Cohen Ragas and Karen Kozlowski (1998) have written a lively and well-illustrated history of lipstick.
13. Claudia Benthien (2002) discusses at length how allusions to facial coloration have been used in literature (especially in the novels of Honoré de Balzac) to convey the emotional states and psychological qualities of literary characters to the reader. On the meteoric rise of cosmetics sales and production, see Ragas and Kozlowski 1998.
14. Fowler 2000. The significance of Ötzi's tattoos and the meaning of their patterns have been the subjects of considerable scholarly and popular debate. Some scholars believe that the tattoos were therapeutic and not decorative.
15. Bogucki 1999.
16. Kirch 1997.
17. Benson (2000) argues that the functions of tattoos may have been particularly important to individuals or populations who had been stripped of their normal "social envelope" (such as recent immigrants to a country or a neighborhood) and who desired an obvious means of self-protection and self-identification. Connor (2004) provides an interesting discussion of the in-

nocence of unmarked skin in contrast to the permanent stain of the tattooed surface.

18. Benson (2000) explores the historical roots of modern Western tattooing and other forms of body modification and cogently summarizes the place of these practices in modern culture.
19. Numerous ethnographic accounts describe the use of tattooing to mark signal events in life history. William Saville (1926, 59–61) provides a particularly detailed description. Jean-Chris Miller (2004) offers an expansive discussion about what motivates people today to decorate themselves with permanent body art.
20. Laser removal of tattoos is generally more successful for darker colors of ink than for light ones, but the procedure is not without risk. Some lighter colors of ink (including two widely used azo compounds) break down into potentially toxic decomposition products when exposed to high-intensity laser irradiation (Vasold et al. 2004).
21. Based on interviews conducted by June Anderson of the California Academy of Sciences in March 1998 with mehndi artists Lila Kent and Ravie Kattaura.
22. Gay and Whittington 2002; Klesse 1999.
23. Stelarc quoted in Benthien 2002, 222. In a 1995 interview conducted by Paolo Atzori and Kirk Woolford of the Academy of Media Arts in Cologne, Germany, Stelarc stated, “I think metaphysically, in the past, we’ve considered the skin as surface, as interface. The skin has been a boundary for the soul, for the self, and simultaneously, a beginning to the world. Once technology stretches and pierces the skin, the skin as a barrier is erased.” The full text of this interview is available online at www.ctheory.net/articles.aspx?id=71.
24. Caliendo, Armstrong, and Roberts 2005.
25. Miller 2004.
26. Groning 1997.
27. Numerous scholars have researched the association of dark skin and inferior social position, especially as it was used to justify the establishment and maintenance of the slave trade; see Babb 1998; Oakes 1998; Iyengar 2005. Lorenz Oken’s *Lehrbuch der Naturphilosophie* (1811) and similar treatises on the cultural valuation of different colors are discussed cogently by Benthien